

What is claimed is:

1. A method for coherently tracking a radio signal including at least one digitally modulated reference carrier, the method comprising the steps of:
demodulating the reference carrier to produce complex coherent reference gains;
detecting a transient that affects the complex coherent reference gains; and
adjusting the complex coherent reference gains in the vicinity of the transient to produce adjusted complex coherent reference gains.
2. The method of claim 1, further comprising the step of:
using a plurality of antenna elements to receive the radio signal, wherein the transient is caused by switching among the antenna elements.
3. The method of claim 1, wherein the transient is impulsive noise.
4. The method of claim 1, wherein the step of adjusting the complex coherent reference gains in the vicinity of the transient comprises the step of:
substituting a previous or future complex coherent reference gain value for the complex coherent reference gain in the vicinity of the transient.
5. The method of claim 1, wherein the step of adjusting the complex coherent reference gains in the vicinity of the transient comprises the steps of:
filtering the complex coherent reference gains to produce smoothed complex coherent reference gains; and
processing the smoothed complex coherent reference gains to ignore values of the complex coherent reference gains closest to the transient and replacing the values of the complex coherent reference gains closest to the transient with the closest value of the complex coherent reference gains that are unaffected by a filter.
6. The method of claim 1, wherein the radio signal comprises a plurality of reference subcarriers, and wherein the complex coherent reference gains in the vicinity of the transient are adjusted for each of the reference subcarriers.
7. The method of claim 1, wherein the step of detecting a transient that affects the complex coherent reference gains comprises the steps of:
processing the complex coherent reference gains for a plurality of reference subcarriers; and

aggregating the complex coherent reference gains over all the reference subcarriers to produce one composite coherent channel reference signal for each OFDM symbol.

8. The method of claim 1, wherein the step of detecting a transient that affects the complex coherent reference gains comprises the steps of:

calculating the magnitude of the difference of a plurality of composite coherent channel reference signals;

determining if the magnitude is a local peak; and

if the magnitude is a local peak, then inversely scaling the magnitude by the sum of the magnitude of the difference.

9. The method of claim 1, wherein the step of detecting a transient that affects the complex coherent reference gains comprises the steps of:

computing a sequence of samples x_n from the complex coherent reference gains;

computing a square of the difference ($diffsq_n$) between samples x_{n+1} and x_{n-1} ;

setting a peak detection variable ($detpeak_n$) equal to one if ($diffsq_n \geq diffsq_{n-1}$) or if ($diffsq_n \geq diffsq_{n+1}$), otherwise setting the peak detection variable to 0; and

indicating the presence of a transient if

$\frac{diffsq_n}{|x_{n+1}|^2 + |x_{n-1}|^2}$ is greater than a predetermined threshold value.

10. The method of claim 1, wherein the step of adjusting the complex coherent reference gains in the vicinity of the transient comprises the steps of:

ignoring values (α) of the complex coherent reference gains close to the transient that include a symbol where the transient is detected; and

replacing the ignored values of α by the closest value of α which is unaffected by a filter used to estimate α .

11. The method of claim 1, wherein the step of adjusting the complex coherent reference gains in the vicinity of the transient comprises the steps of:

if a corrupted value (α) of the complex coherent reference gain is detected within 3 symbols ahead of a present symbol, then using a value of α (α_{n-4}), which is 4 symbols ahead of the transient instead of using a present value of α ;

if the corrupted value (α) of the complex coherent reference gain is detected within 3 past symbols, then using a value of α (α_{n+4}), which is 4 symbols after the transient instead of using the present value of α ;

if the corrupted value (α) of the complex coherent reference gain is at a location of a presently detected symbol, then using the average of α of samples which are ± 4 symbols on either side of the transient $\frac{\alpha_{n-4} + \alpha_{n+4}}{2}$; and

if the corrupted value (α) of the complex coherent reference gain is not detected, then using the present input values of α .

12. A receiver for coherently tracking a radio signal including at least one digitally modulated reference carrier, the receiver comprising:

an input for receiving the radio signal; and

a processor for demodulating the reference carrier to produce complex coherent reference gains, for detecting a transient that affects the complex coherent reference gains, and for adjusting the complex coherent reference gains in the vicinity of the transient to produce adjusted complex coherent reference gains.

13. The receiver of claim 12, further comprising:

a plurality of antenna elements coupled to the input, wherein the transient is caused by switching among the antenna elements.

14. The receiver of claim 12, wherein the transient is impulsive noise.

15. The receiver of claim 12, wherein the processor substitutes a previous or future complex coherent reference gain value for the complex coherent reference gain in the vicinity of the transient.

16. The receiver of claim 12, wherein the processor filters the complex coherent reference gains to produce smoothed complex coherent reference gains, and processes the smoothed complex coherent reference gains to ignore values of the complex coherent reference gains closest to the transient and replace the values of the complex coherent reference gains closest to the transient with the closest value of the complex coherent reference gains that are unaffected by a filter.

17. The receiver of claim 12, wherein the radio signal comprises a plurality of reference subcarriers, and wherein the complex coherent reference gains in the vicinity of the transient are adjusted for each of the reference subcarriers.

18. The receiver of claim 12, wherein the processor processes the complex coherent reference gains for a plurality of reference subcarriers and aggregates the complex coherent reference gains over all the reference subcarriers to produce one composite coherent channel reference signal for each OFDM symbol.

19. The receiver of claim 12, wherein the processor calculates the magnitude of the difference of a plurality of composite coherent channel reference signals; determines if the magnitude is a local peak; and if the magnitude is a local peak, then inversely scales the magnitude by the sum of the magnitude of the difference.

20. The method of claim 12, wherein the processor receives a sequence of samples x_n ; computes a square of the difference ($diffsq_n$) between samples x_{n+1} and x_{n-1} ; sets a peak detection variable ($detpeak_n$) equal to one if ($diffsq_n \geq diffsq_{n-1}$) or if ($diffsq_n \geq diffsq_{n+1}$), otherwise setting the peak detection variable to 0; and indicates the presence of a transient if $\frac{diffsq_n}{|x_{n+1}|^2 + |x_{n-1}|^2}$ is greater than a predetermined threshold value.

21. The receiver of claim 12, wherein the processor ignores values (α) of the complex coherent reference gains close to the transient that include a symbol where the transient is detected; and replaces the ignored values of α by the closest value of α which is unaffected by a filter used to estimate α .

22. The receiver of claim 12, wherein:
if a corrupted value (α) of the complex coherent reference gain is detected within 3 symbols ahead of a present symbol, then using a value of α (α_{n-4}), which is 4 symbols ahead of the transient instead of using a present value of α ;

if the corrupted value (α) of the complex coherent reference gain is detected within 3 past symbols, then using a value of α (α_{n+4}), which is 4 symbols after the transient instead of using the present value of α ;

if the corrupted value (α) of the complex coherent reference gain is at a location of a presently detected symbol, then using the average of α of samples which are ± 4 symbols on either side of the transient $\frac{\alpha_{n-4} + \alpha_{n+4}}{2}$; and

if the corrupted value (α) of the complex coherent reference gain is not detected, then using the present input values of α .

23. A receiver for coherently tracking a radio signal including at least one digitally modulated reference carrier, the receiver comprising:

an input for receiving the radio signal; and

means for demodulating the reference carrier to produce complex coherent reference gains, for detecting a transient that affects the complex coherent reference gains, and for adjusting the complex coherent reference gains in the vicinity of the transient to produce adjusted complex coherent reference gains.

24. The receiver of claim 23, further comprising:

a plurality of antenna elements coupled to the input, wherein the transient is caused by switching among the antenna elements.

25. The receiver of claim 23, wherein the transient is impulsive noise.

26. A method of estimating noise variance of symbols in a radio signal when noise can include impulsive-like samples among Gaussian-like noise samples, the method comprising the steps of:

adding input samples and coherent reference samples to produce error samples;

computing the squares of the error samples;

separating squared Gaussian-like noise samples and squared impulsive noise samples; and

nonlinear filtering of the squares of the error samples to produce a noise variance estimate representing the sum of long-term-averaged Gaussian-like noise variance, and short-term impulsive noise variance.

27. The method of claim 26, including the step of:

determining if each squared noise sample is impulsive-like by comparing the sample to a multiple of a present average noise variance estimate; and

if the squared noise sample is not determined to be impulsive-like, then inputting the squared noise sample to a filter to be used to estimate the long-term-averaged Gaussian-like noise variance; and

if the noise sample is determined to be impulsive-like, then reducing the squared noise sample into the filter to prevent overestimation of the long-term Gaussian-like noise variance estimate.

28. The method of claim 27, including the step of:

creating an excess-noise value including of a portion of the reduced squared noise sample; and

adding the excess noise value to the Gaussian-like noise variance estimate to produce a composite noise variance representing the sum of the long-term-averaged Gaussian-like noise variance, and the short-term impulsive noise variance.